FENOC
FirstEnergy Nuclear Operating Company

James H. Lash
Site Vice President

724-682-5234
Fax: 724-643-8069

December 6, 2005
L-05-195

U. S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, DC 20555-0001

Subject: Beaver Valley Power Station, Unit No. 1
BV-1 Docket No. 50-334, License No. DPR-66
Additional Information Regarding Responses to RAI Dated July 28, 2005 in Support of License Amendment Request No. 320

On April 13, 2005, FENOC submitted LAR No. 320 for BVPS Unit No. 1 by letter L-05-069 (Reference 1).

By letters dated July 28, 2005 and September 28, 2005, the U.S. Nuclear Regulatory Commission (NRC) issued requests for additional information (RAI) pertaining to FirstEnergy Nuclear Operating Company (FENOC) License Amendment Request (LAR) No. 320 Replacement Steam Generators for Beaver Valley Power Station (BVPS) Unit No. 1. Responses to the July 28, 2005 and September 28, 2005 RAI questions were provided in FENOC letters L-05-137 dated August 26, 2005, and L-05-165 dated November 18, 2005, respectively.

Enclosure 1 and 2 provide updated responses to RAI Questions B.1 and C.5 of letter L-05-137 and to RAI Questions 5 and 6 of letter L-05-165. The changes are due to a revision of the analysis for the Steam Generator Tube Rupture (SGTR) Operational Response Case which provides thermal-hydraulic tube rupture data for use in radiological dose consequence analysis. The revised analysis provides additional operator action time for isolation of a failed open steam generator atmospheric dump valve (ADV) on the ruptured steam generator. Note that the Operational Response Case demonstrates that the licensing basis dose analysis provided in Reference 1 is bounding. As a result, there is no change required to the dose analysis provided in Reference 1.

The updated responses provided by this transmittal have no impact on either the proposed Technical Specification changes or the no significant hazards consideration transmitted by Reference 1.

A001

No new regulatory commitments are contained in this submittal. If you have questions or require additional information, please contact Mr. Gregory A. Dunn, Manager, Licensing, at 330-315-7243.

I declare under penalty of perjury that the foregoing is true and correct. Executed on December 6, 2005.

Sincerely,

James H. Lash

Enclosures:
1. Updated Responses to RAI Questions B.1 and C.5 (from RAI dated July 28, 2005)
2. Updated Responses to RAI Questions 5 and 6 (from RAI dated September 28, 2005)

References:
1. FENOC Letter L-05-069, License Amendment Request 320, dated April 13, 2005.

c: Mr. T. G. Colburn, NRR Senior Project Manager
Mr. P. C. Cataldo, NRC Senior Resident Inspector
Mr. S. J. Collins, NRC Region I Administrator
Mr. D. A. Allard, Director BRP/DEP
Mr. L. E. Ryan (BRP/DEP)

UPDATED RESPONSES TO RAI QUESTIONS B.1 AND C.5

(FROM RAI DATED JULY 28, 2005)

Additional information is being provided to update responses to RAI Questions B.1 and C.5 relative to the steam generator tube rupture event for BVPS Unit No. 1.

B.1 Original Question (from RAI dated July 28, 2005)

With regard to Enclosure 1 of your July 8, 2005, extended power uprate (EPU) RAI response:

Item X.1, Section 5.4 of Enclosure 1 to your July 8, 2005, RAI response related to your extended power uprate LAR indicated that it would take 51 minutes to terminate the radioactive release from the ruptured tube's SG. Please provide the radiological analyses for this scenario which demonstrates that the 30-minute isolation time of your April 13, 2005, LAR is more limiting.

Updated Response *(with changes from previous response provided in italicized bold type):*

The licensing basis thermal hydraulic analysis model used to determine the post accident releases and associated dose consequences at the site boundary and control room for the BVPS-1 SGTR with RSGs and at EPU conditions is a simplified model, which was the common industry standard prior to 1980. It is based on a hand calculation that predicts conservative break flows and steam releases, and utilizes a termination time of 30 minutes for the break flow and releases from the ruptured SG. The dose consequences, based on break flows and steam releases associated with the above licensing basis thermal hydraulic analysis, were submitted to NRC in Enclosure 2, Section 5.11.9.8 of the BVPS-1 RSG LAR as it was determined to be bounding.

BVPS-1 has also performed an analysis that documents the dose consequences based on values for break flows and steam releases developed by Westinghouse with LOFTTR2 computer modeling. An "operational response case" was considered that reflects a more realistic EPU SGTR transient analysis with RSGs, and takes into consideration a simulator based operator action time. The operational response case utilized a calculated break flow termination time of ***66.5*** minutes as opposed to the 30-minute licensing basis model. The operational response model addresses single failure considerations, and includes margin for steam generator overfill. The operational response case was intended to be more consistent with current assumptions required of a SGTR transient analysis, as opposed to the BVPS-1 licensing basis model. Note that the 51 minute isolation time referred to in the NRC question regarding response to RAI Item X.1 pertained to an evaluation performed to support operation at the current power level.

The table below (Table B.1, Analysis Assumptions and Key Parameter Values, BVPS-1 Steam Generator Tube Rupture – Operational Response Case) lists the key input parameters from the thermal hydraulic analysis associated with the operational response case that were utilized to develop the radiological consequences following a SGTR at BVPS-1. The description of the dose calculation assumptions and methodology presented in Enclosure 2, Section 5.11.9.8 of the RSG LAR is also applicable to the operational response case. The analysis determined that the site boundary and control room dose estimates using the licensing

basis thermal hydraulic analysis model are conservative and bound the dose estimates developed utilizing the thermal-hydraulic input data based on the operational response case.

Table B.1

Analysis Assumptions and Key Parameter Values
BVPS-1 Steam Generator Tube Rupture[1] – Operational Response Case

Core Power Level	2918 MWt
Reactor Coolant Mass	373,100 lbm
Break Flow to Faulted Steam Generator (SG)	0-120 sec (9,500 lbm) 120-*3988* sec (*196,500* lbm)
Time of Reactor Trip	120 sec
Amount of Break Flow that Flashes	0-120 sec (1810 lbm) 120-*2142.5* sec (*8635.3* lbm)
Leakage Rate to Intact SG's	150 gpd @ 63°F and 1 ATM for each SG
Failed/Melted Fuel Percentage	0%
RCS Tech Spec Iodine & NG Concentration	Table 5.11.4-1 (0.35 μCi/gm DE-I131)
RCS Equilibrium Iodine Appearance Rates	Table 5.11.4-2 (0.35 μCi/gm DE-I131)
Pre-Accident Iodine Spike Activity	Table 5.11.4-2 (21 μCi/gm DE-I131)
Accident Initiated Spike Appearance Rate	335 times equilibrium
Duration of Accident Initiated Spike	4 hours
Secondary System Release Parameters:	
Intact SG Liquid Mass (min)	91,953 lbm
Faulted SG Liquid Mass (min)	91,953 lbm
Initial SG Liquid Mass per SG's	91,953 lbm
Tech Spec Activity in SG liquid	Table 5.11.4-1 (0.1 μCi/gm DE-I131)
Form of All Iodine Released to the Environment via SG's	97% elemental; 3% organic
Iodine Partition Coefficient (unflashed portion)	100 (all tubes submerged)
Fraction of Iodine Released (flashed portion)	1.0 (Released without holdup)
Fraction of Noble Gas Released from any SG	1.0 (Released without holdup)
Partition Factor in Condenser	100 elemental iodine 1 organic iodine/Noble Gases
Steam Flowrate to Condenser	0-120 sec (1202 lbm/sec from faulted SG) 0-120 sec (1188 lbm/sec per intact SG)
Faulted SG Steam Releases via MSSV/ADVs	120 sec – *3988* sec (*89,500* lbm) 2 hr – 8 hr (*42,600* lbm[2])
Intact SG Steam Releases via MSSV/ADVs	120 sec – *3988 sec (197,400 lbm)* *3988 sec – 7200 sec (228,900 lbm)* 2 hr – 8 hr (*768,700* lbm)
Termination of Release from SGs	8 hours
Environmental Release Points	0-120 sec (Condenser Air Ejector) 120 sec –8 hr (MSSVs/ADVs)
CR Emergency Ventilation: Initiation Signal/Timing	8 hours after DBA
Control Room (CR) is maintained in normal ventilation mode	@16,200 cfm (min) for 30 min
CR Purge Initiation (Manual) Time and Rate	

Notes:

(1) Steam generator parameter values reflect the Replacement Steam Generators and Operations Assessment

(2) Brief depressurization release in preparation of shutdown cooling

C.5 Original Question
What is the basis for assuming that the faulted SG will be isolated in 30 minutes as stated in Table 5.11.9-5?

Updated Response *(with changes from previous response provided in italicized bold type):*

As described in Section 5.4.1 of Enclosure 2 of the April 13, 2005 RSG LAR and discussed in the July 8, 2005 EPU RAI response to Item X.1, Section 5.4 of Enclosure 1, the BVPS-1 licensing basis analysis for the SGTR event is a mass and energy balance calculation that assumes that the steam release from the ruptured steam generator is terminated at 30 minutes after initiation of the SGTR.

A supplemental BVPS-1 SGTR operational response analysis has been performed to show that the ruptured steam generator will not overfill and to develop thermal and hydraulic SGTR input data for radiological dose analysis. The supplemental SGTR operational response analysis includes consideration of single active failures, and the timing of operator actions in accordance with plant Emergency Operating Procedures (EOPs) and demonstrated performance during simulator exercises. The supplemental analysis case for SGTR input data for radiological dose analysis showed that primary and secondary pressures are equilibrated and that primary-to-secondary break flow and steam releases from the ruptured steam generator are terminated at ***66.5*** minutes after initiation of the SGTR. The supplemental analysis SGTR input data was used in supplemental radiological dose analysis that confirmed the conservatism in the licensing basis dose calculations based on the assumed 30 minute termination of break flow and steam releases from the ruptured steam generator.

This supplemental BVPS-1 SGTR operational response and radiological dose analysis confirmed that the 30 minute termination licensing basis analysis is conservative from a radiological dose standpoint even though the break flow termination time is greater than 30 minutes. This is because the 30 minute termination licensing basis analysis includes other conservative assumptions that result in higher break flow that flashes from the ruptured steam generator (which is the dominant contributor to dose consequences) than for the SGTR operational response analysis case where break flow and steam releases are terminated in ***66.5*** minutes.

Enclosure 2 of L-05-195

UPDATED RESPONSES TO RAI QUESTIONS 5 AND 6

(FROM RAI DATED SEPTEMBER 28, 2005)

Additional information is being provided to update responses to RAI Questions 5 and 6 relative to the steam generator tube rupture event for BVPS Unit No. 1.

5. Original Question:

Section 5.4 of the April 13, 2005, RSG LAR states that an operational response analysis of steam generator tube rupture (SGTR) was performed for BVPS-1. The NRC staff requests that the licensee provide a table listing the sequence of events and times from break initiation to event termination that shows operators can terminate the break flow from the ruptured SG within 51 minutes of accident initiation for the SG replacement and extended power uprate (EPU) conditions. Additionally, the staff requests that the licensee provide the results of the SGTR thermal-hydraulic analysis over time showing the pressurizer pressure, intact and ruptured SGs pressures, and ruptured SG water volume for the analysis to demonstrate that no overfilling of the SG occurs.

Updated Response *(with changes from previous response provided in italicized bold type): Note, there were no changes to Table 5-2 or to the Figures 5-1 through 5-6. They are being provided for completeness.*

The SGTR operational response analysis for EPU conditions with RSG included cases to provide thermal-hydraulic tube rupture data for use in radiological dose consequence analysis and for evaluation of margin to overfill. The sequence of events for these cases is shown in Tables 5-1 and 5-2, respectively. The sequence of events tables show that termination of the event (i.e., termination of primary-to-secondary break flow) occurs at ***3988*** seconds (approximately ***66.5*** minutes) and 3578 seconds (approximately 60 minutes), respectively, for EPU conditions with RSGs. ***For BVPS-1, the termination time used in the radiological dose consequence analysis was increased to allow additional operator action time for the operator to isolate the failed-open steam generator atmospheric dump valve (ADV) on the ruptured steam generator.*** Figures 5-1 through 5-6 show the response of pressurizer level, pressurizer pressure, intact and ruptured SG pressure, intact loop RCS temperatures, primary-to-secondary break flow, and ruptured SG water volume for the margin to overfill case. The response to Question 6 provides information regarding the analysis performed in the 1990's for current power conditions that established a break flow termination time of 51 minutes.

Table 5-1
BVPS-1 Thermal-Hydraulic Analysis Sequence of Events

Event (Thermal & Hydraulics for Doses)	Time (seconds)
Steam generator tube rupture	0
Reactor trip – Overtemperature Delta-T	120
Safety injection initiated	148
Isolate auxiliary feedwater to ruptured steam generator	573
Ruptured steam generator steamline isolated	1122
Ruptured steam generator atmospheric dump valve (ADV) fails open	1124
Ruptured steam generator ADV block valve closed *	***1724***
Reactor coolant system cooldown initiated	***1868***
Reactor coolant system cooldown terminated	***2934***
Reactor coolant system depressurization initiated	***3116***
Reactor coolant system depressurization terminated	***3208***
Safety injection terminated	***3502***
Steam relief to maintain sub-cooling	***3570***
Break flow terminated	***3988***

* ***NOTE:*** ***Operator action time to isolate the failed-open ADV on the ruptured steam generator was increased to allow for additional operator action time margin.***

Table 5-2
BVPS-1 Margin to Overfill Analysis Sequence of Events

Event (Margin to Overfill)	Time (seconds)
Steam generator tube rupture	0
Reactor trip – Overtemperature Delta-T	106
Auxiliary feedwater initiated	121
Safety injection initiated	197
Isolate auxiliary feedwater to ruptured steam generator	515
Ruptured steam generator steamline isolated	1110
Reactor coolant system cooldown initiated	1254
Reactor coolant system cooldown terminated	2466
Reactor coolant system depressurization initiated	2646
Reactor coolant system depressurization terminated	2752
Steam relief to maintain subcooling	2952
Safety injection terminated	3046
Break flow terminated	3578
	Volume (ft^3)
Available ruptured steam generator secondary volume	5630
Maximum ruptured steam generator secondary volume	5602
Available ruptured steam generator secondary volume to overfill	28

Figure 5-1
Pressurizer Level

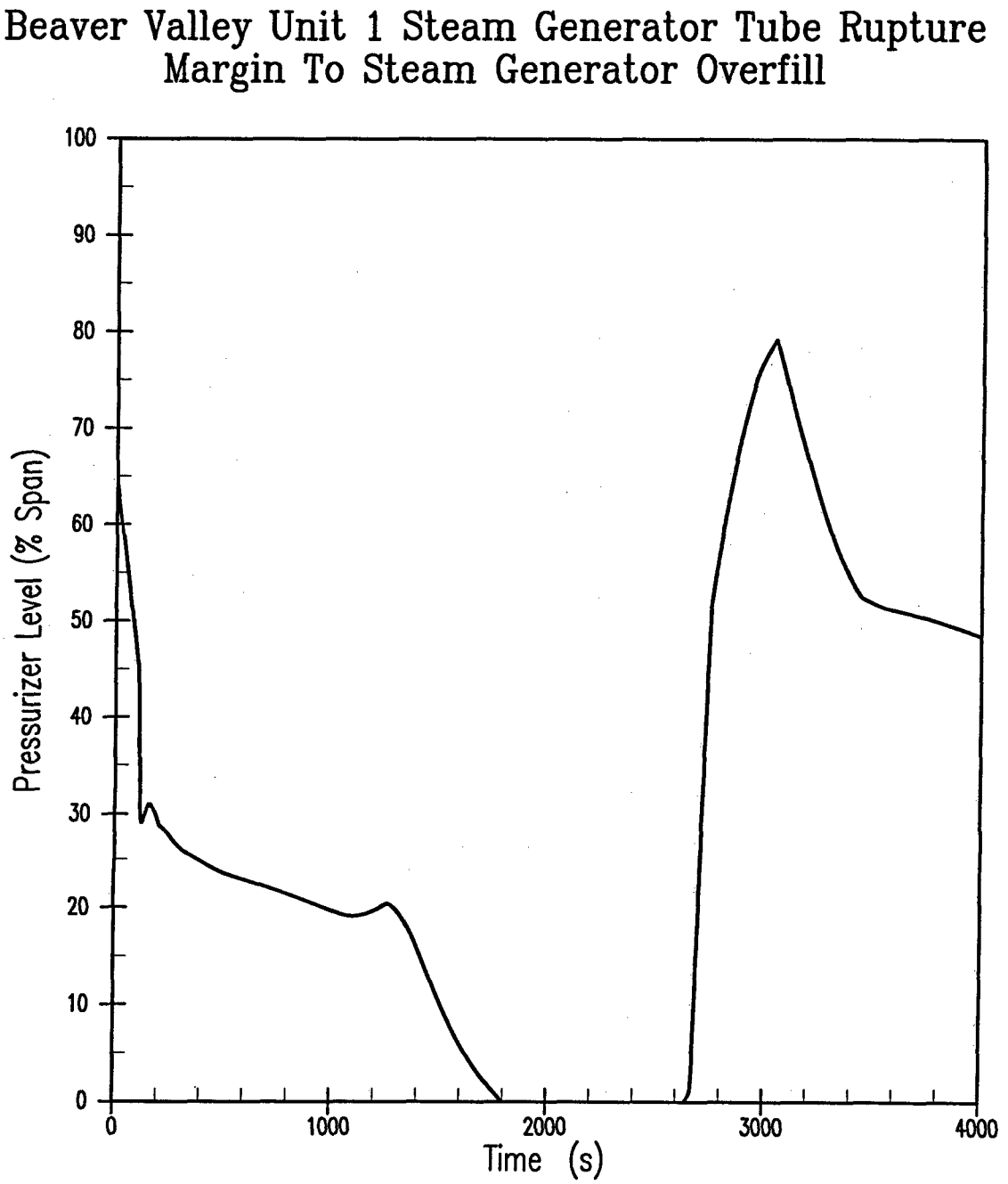


Figure 5-2
Pressurizer Pressure

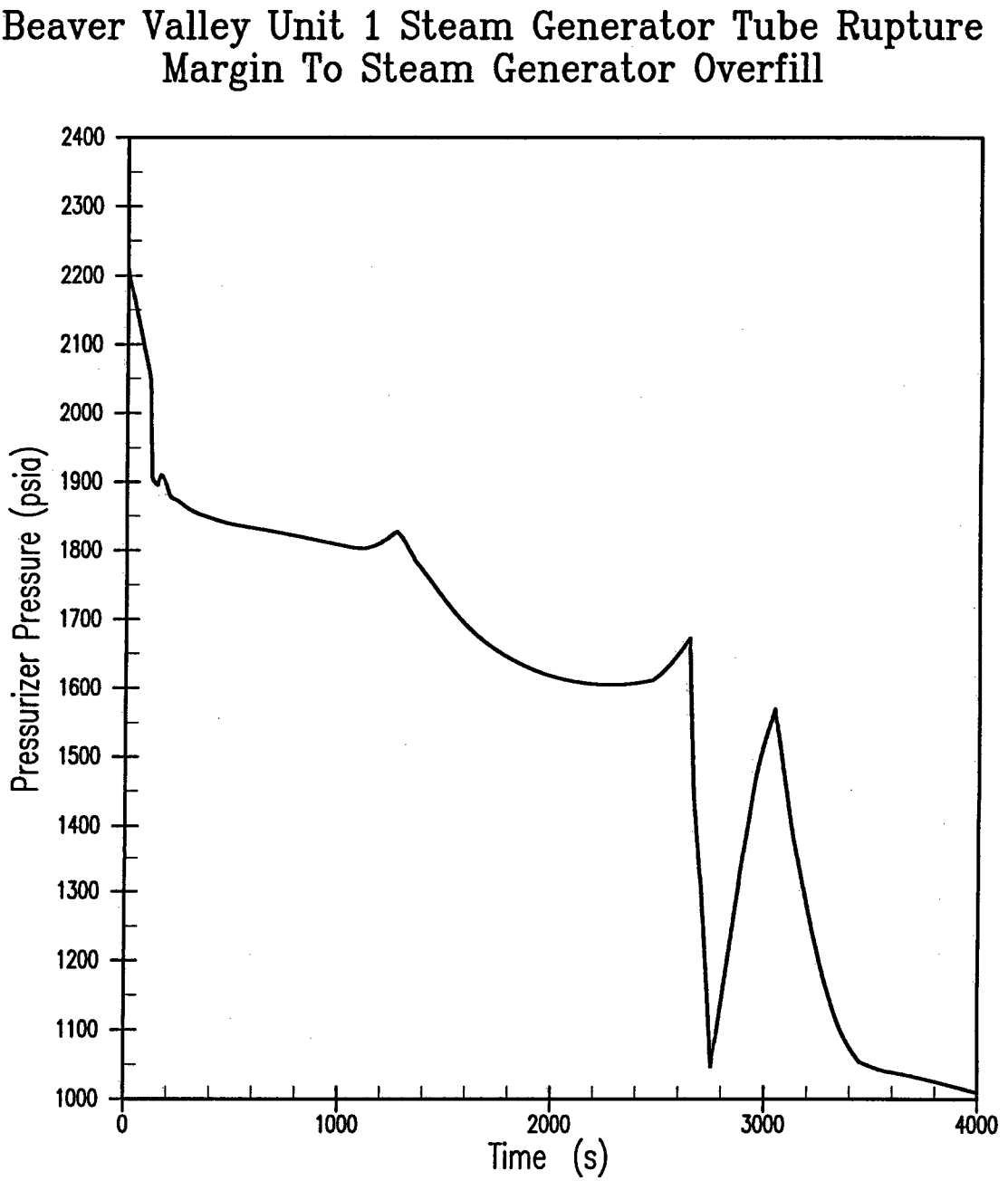


Figure 5-3
Secondary Pressure

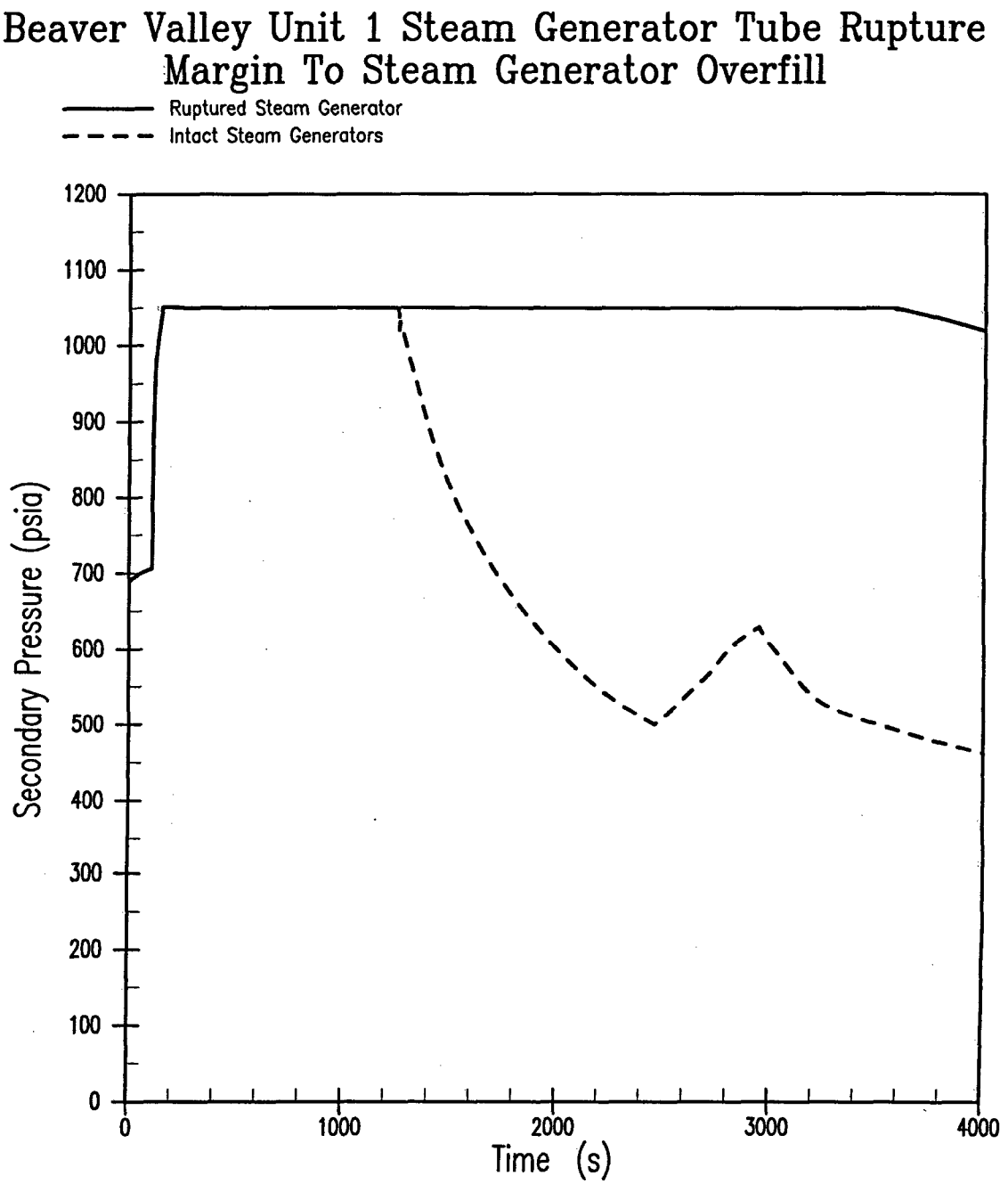


Figure 5-4
Intact Loop RCS Temperatures

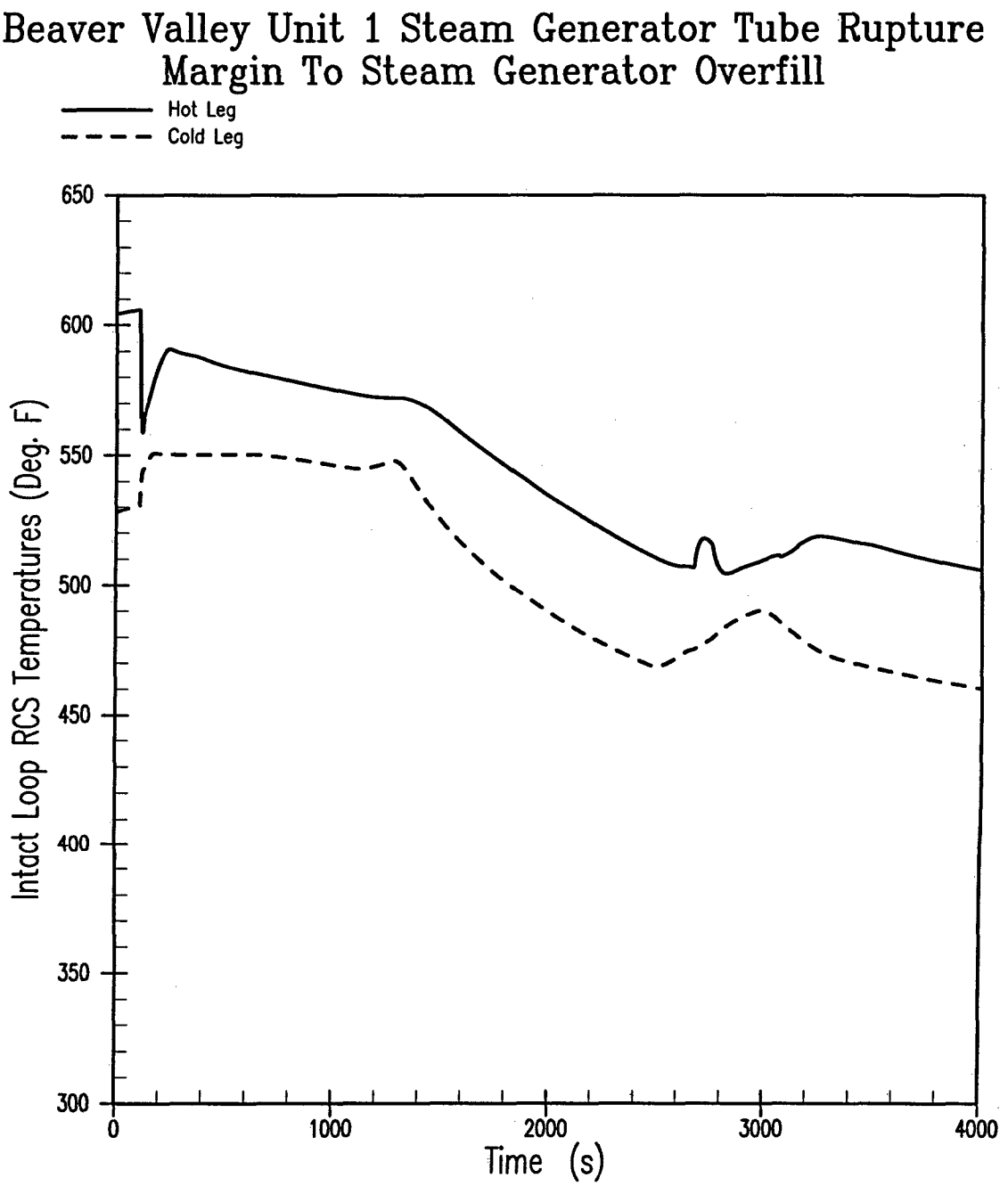


Figure 5-5
Primary-to-Secondary Break Flow

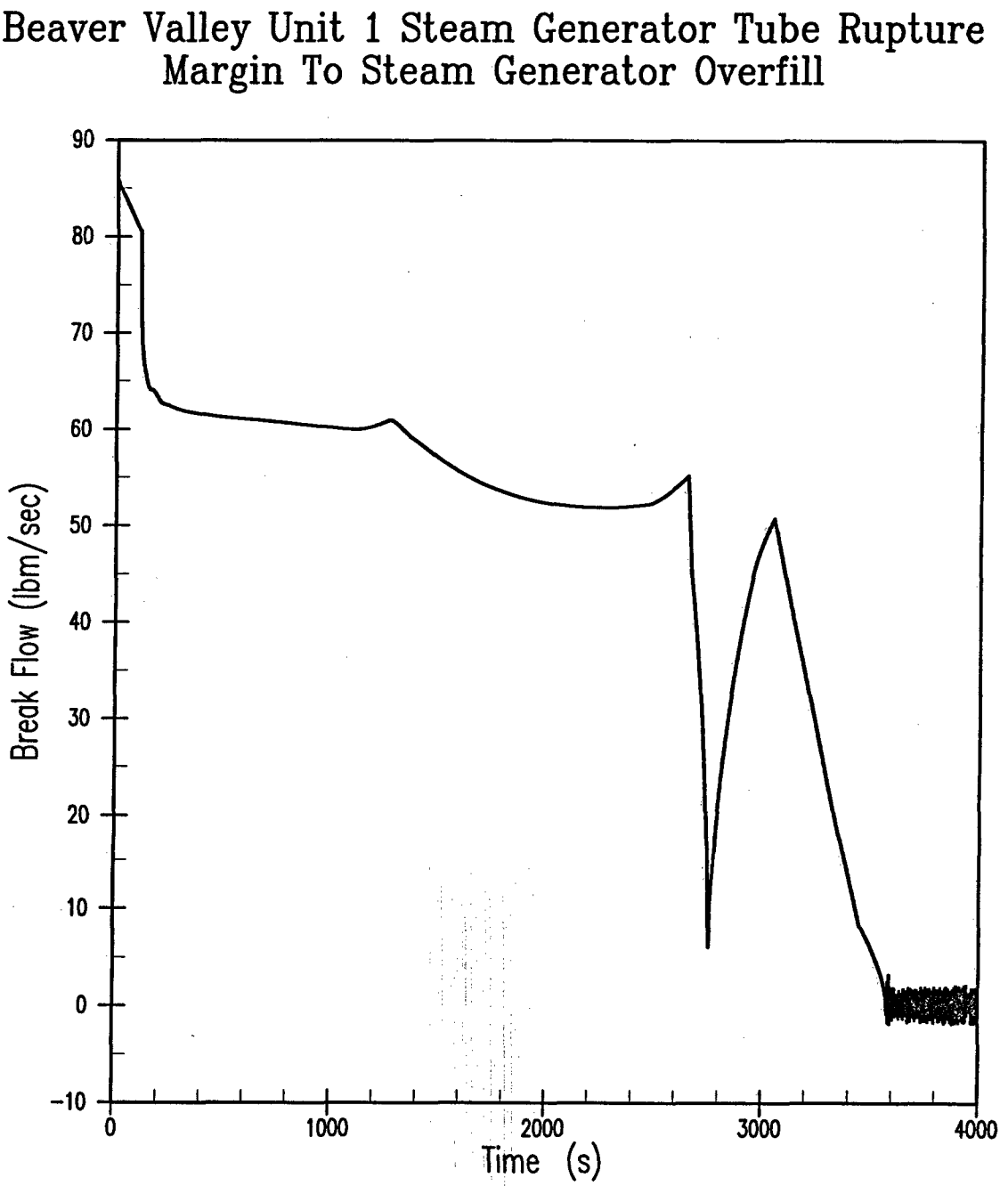
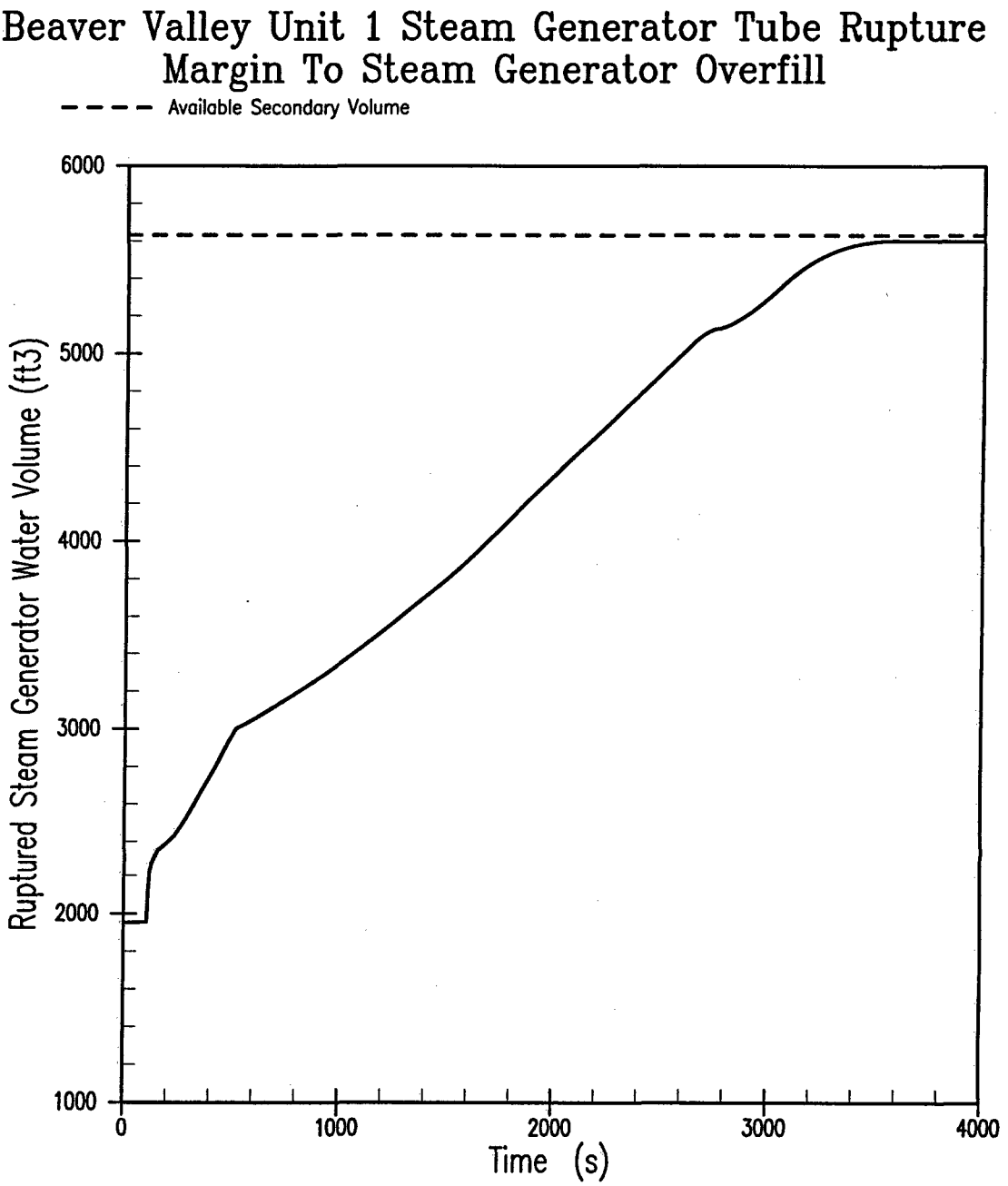


Figure 5-6
Ruptured Steam Generator Water Volume



6. Original Question:

The NRC staff requests that the licensee provide the technical justification as to why a transient break flow analysis was not performed for the SGTR and why the 30-minute release assumption is conservative for the analysis when termination of the event exceeds 30 minutes.

Updated Response *(with changes from previous response provided in bold type):*

The BVPS-1 SGTR licensing basis analysis methodology (Section 5.4 of Enclosure 2 of FENOC Letter L-05-069) consists of a thermal-hydraulic analysis to provide tube rupture data (e.g., break flow and steam releases) as input to the BVPS-1 SGTR radiological dose consequence analysis. This licensing basis methodology includes an assumption that the break flow and steam release from the ruptured steam generator are terminated at 30 minutes.

As described in the response to NRC RAI X.1 of Enclosure 2 of the July 8, 2005 (L-05-112) Response to RAIs on the EPU LAR, a condition report was written in the 1990's that documented that more than 30 minutes was required to terminate radioactive steam release from the ruptured steam generator. At that time through the corrective action process, the break flow termination time was revised to 51 minutes. Even though the break flow termination time increased, it was determined that the primary-to-secondary break flow based on the assumptions that terminate break flow in 30 minutes actually resulted in a higher primary-to-secondary break flow than the case that terminated break flow in 51 minutes. Consequently, it was concluded that the licensing basis methodology including the assumption of break flow termination at 30 minutes was conservative with respect to a transient break flow analysis that included a longer break flow termination time.

This approach established in the 1990's was retained for the BVPS-1 SGTR analysis for EPU conditions with the RSGs. A SGTR licensing basis methodology analysis was performed including the 30-minute isolation time to provide conservative break flow and steam release data as input to the SGTR radiological dose consequence analysis. The results of this SGTR licensing basis methodology analysis are presented in Section 5.4.1 of Enclosure 2 of the RSG LAR.

To develop operator action information for operator training as well as to confirm that the licensing basis methodology analysis continues to provide conservative estimates for the radiological dose consequences following a SGTR, a SGTR operational response (transient break flow) analysis was performed for BVPS-1 at EPU conditions with the RSGs. As noted in Section 5.4 of Enclosure 2 of the April 13, 2005 (L-05-069) RSG LAR, this operational response analysis demonstrates that the BVPS-1 SGTR licensing basis analysis methodology is conservative.

The SGTR radiological dose consequence analysis using the tube rupture data (e.g., break flow and steam releases) from the BVPS-1 SGTR operational response (transient break flow) analysis was provided in response to NRC RAI B.1 of Attachment A of the August 26, 2005 (L-05-137) Response to RAIs on the RSG LAR. This SGTR radiological dose consequence analysis demonstrates that the SGTR licensing basis methodology analysis with a break flow termination time of 30 minutes is more limiting than the operational response analysis with a break flow termination time of ***3988*** seconds (approximately ***66.5*** minutes), which is the break

flow termination time calculated for the SGTR operational response analysis radiological dose consequence case at EPU conditions with RSGs.

The margin to overfill analysis from the operational response (transient break flow) analysis is provided in the response to Question 5. This margin to overfill analysis demonstrates that the primary-to-secondary break flow into the ruptured steam generator is terminated prior to overfilling the ruptured steam generator. The operational response analysis for the margin to overfill case at EPU conditions with RSGs shows a break flow termination time of 3578 seconds (approximately 60 minutes). The operator action times associated with this analysis have been provided as input to operator training. Additional information pertaining to operator actions and operator training has been provided in Enclosure ***3*** of the October 7, 2005 (L-05-154) EPU LAR Supplemental Information.

This information along with the more detailed information in the referenced RAIs provide the technical justification as to why the 30-minute SGTR licensing basis methodology analysis is retained for the BVPS-1 SGTR and why the 30-minute release assumption is conservative for the radiological dose consequence analysis when termination of the event exceeds 30 minutes. The technical justification includes a SGTR operational response (transient break flow) analysis as described in this response.

Note that the operator response times for the BVPS-1 SGTR operational response analysis ***have been*** validated as part of the emergency operating procedure (EOP) simulator validation process. One operator action time included in the SGTR operational response analysis case to provide thermal-hydraulic tube rupture data for use in radiological dose consequence analysis is the "local isolation of a failed-open atmospheric dump valve on the ruptured SG within 6.5 minutes after the valve fails open." The atmospheric dump valve (ADV) is assumed to fail open when the main steam line isolation valve for the ruptured SG is closed. This operator action time ***has been*** validated and is ***reflected*** in the BVPS Corrective Action Program. In order to afford additional operator response time for this local operator action, additional analysis ***has been*** performed to allow up to a 10-minute operator action time. The analysis results for 10-minute operator action time still support the conclusion that the BVPS-1 SGTR licensing basis methodology with a break flow termination time of 30 minutes is more limiting with respect to radiological dose consequences than the operational response analysis. The results of the revised SGTR radiological dose consequence analysis and the validation of the 10-minute